Presentation

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

FEDERAL ON-SCENE COORDINATOR'S REPORT

WESTLEY TIRE FIRE
STANISLAUS COUNTY, CALIFORNIA

SEPTEMBER 22, 1999

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U.S. EPA REGION IX

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August 30, 2000

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WESTLEY, STANISLAUS COUNTY, CALIFORNIA

VI. Executive Summary

In the past couple of years there has been a rash of tire fires in the United States. EPA Region 9 has experienced a number of tire fires.

Date	Site Name/Location	Size of Pile
1996	Panoche Hills Tire Fire, Fresno County	3 million tires
1997	Gila River Tire Fire, Arizona	3 million tires
1998	Tracy Tire Fire, San Joaquin County	5 million tires
1998	Ordot Landfill Tire Fire, Guam	1 million tires
1999	Westley Tire Fire, Stanislaus County	7 million tires

Large tire fires are a major hazardous material event where large populations are affected and they can cause severe environmental damage. The cost of fighting these fires are staggering. For a response to be successful, responders must recognize that tire fires are a unique multi-category event containing the elements of a major fire, hazardous materials release and oil spill discharge combined into one event. Each tire fire incident is a unique situation that may require innovative fire suppression strategies. The primary tactics that have been used include, let it burn, bury and smother with sand or dirt, and extinguish with water and foam. Past experience with foam suppression methods at tire fires have indicated very limited success on mostly small burning tire piles. The use of other suppression methods such as injection of liquid carbon dioxide, cryogenic gases or use of accelerants have been much less successful and can be very hazardous to work with. These methods are not normally recommended. The choice of tactics depends on many factors including the size of the tire pile, configuration of the tires, surrounding terrain, public health exposures, risk to natural resources, feasibility, cost, and the acceptance of trade-offs such as increasing air pollution as in the "let it burn" scenario in exchange for reducing the potential to contaminate ground water supplies as in the "water suppression" scenario. Tactical decisions can be influenced by the degree of community and political involvement in the area. This was the first successful extinguishment of a large tire fire using water and foam as the sole suppression method. However, the initial decision was not to use water and foam to extinguish the fire due to containment and environmental concerns. Governmental agencies were concerned about the containment of massive volumes of contaminated runoff and impacts to surface and ground water. It was interesting to see how the fire-fighting strategies evolved at this incident.

On September 22, 1999, a lightning strike ignited a fire in the Filbin tire pile located in a canyon on the east slope of the coastal mountain range. The tire dump contained an estimated seven million scrap tires piled on steep slopes of the canyon. The fire spread quickly and engulfed most of the main tire pile. The tremendous smoke plume from the tire fire impacted nearby farming communities and caused widespread concern of potential health affects from exposure to the smoke emissions. The tire fire produced large volumes of pyrolytic oil that flowed off the slope and into the drainage of an intermittent stream. The oil runoff was initially contained behind an existing stock watering pond consisting of a small earthen dam and impoundment structure. A reduction in smoke emissions was evident as the tire fire entered into the smoldering stage.

The burning tires in the drainage ignited the oil flowing in the stream. The large oil fire significantly increased the smoke emissions and a local climatic inversion caused the smoke to remain close to ground level. The response to the oil and tire fires quickly overwhelmed the resources of the local and State agencies The U.S. EPA Federal On-Scene Coordinator (FOSC) immediately responded using Oil Pollution Act of 1990 (OPA) authority. The FOSC quickly mobilized EPA's contractors and the U.S. Coast Guard Pacific Strike Team. On the recommendations of the U.S. Coast Guard, the FOSC directed EPA's cleanup contractor, IT Corporation, to procure the services of Williams Fire and Hazard Control to fight the oil fire. Due to the geographic setting, the oil flowed away from the tire piles resulting in a slower burning fire. It was discovered that only the top ten feet of tires were burning. A tactical plan was developed to implement a safe and effective suppression of the fire. Large excavators and special foam delivery apparatus were used to extinguish fires one slope at a time while moving up the canyon. It took 27 days to extinguish the fire.

Over 250,000 gallons of pyrolytic oil were recovered from the containment pond. An estimated 4 million gallons of contaminated fire fighting water were impounded on site in a series of constructed basins within the drainage channel. Total EPA emergency response costs were estimated to be $3.5 million. Future work will involve site winterization, characterization and remediation.

The response action was highly successful. Some of the most difficult problems that were encountered included working in extremely hot and unstable fire conditions, maneuvering heavy equipment on steep slopes, deep and spongy tire piles, controlling massive volumes of oil and water runoff, coordinating with local and State governmental agencies, forming a fully integrated and effective Unified Command, and the recycling of pyrolytic oil under current California hazardous waste regulations.

A. Chronology of Events

09/22/99 - Tire pile was ignited by a lighting strike at 0400
EPA received initial notification from CIWMB at 0900
Hundreds of local and State responders mobilized to contain the blaze
Multi-agency meeting held in Modesto
Decision made to "let it burn", fire was contained in the canyon

09/23/99 - Oil slick observed on surface of pond at 0430

CDF transferred lead to County and demobilized
Thick pyrolytic oil flowing into pond observed at 1200

09/24/99 - DTSC ERU contractor began oil recovery operations at pond
- Smoke emissions significantly reduced due to crust formation

09/25/99 - EPA issued verbal Notice of Federal Interest to Filbin

09/26/99 - Large oil fire in drainage ignited by burning tires
- Oil fire significantly increased smoke emissions

09/27/99 - Oil fire ignited a large pile of unburned tires across drainage
- Fire jumped breaks and ignited a 1,500 acre grassland fire at 0200
- Multi-agency meeting held to form a Unified Command
- Recovered a total of 45,000 gallons of oil to date

09/28/99 - Volunteer fire department mobilized to extinguish the oil fire
- The immensity of the fire quickly overwhelmed local resources
- EPA FOSC initiated federal response action using OPA authority
- EPA FOSC activated federal response team (ERRS, START, USCG PST)

09/30/99 - Williams Fire & Hazard Control arrived on scene

10/01/99 - Williams fire-fighters extinguished oil fire
- Recovered a total of 115,000 gallons of oil to date
- Estimated 200,000 gallons of oil contained in on-site pond and tanks

10/02/99 - Commenced overhauling burning tire debris in lower canyon areas

10/04/99 - Town Hall Community Meeting held a Patterson High School

10/07/99 - Began shipments of oil to Evergreen Oil Company for recycling

10/08/99 - Filbin's proposal to use soil to smother the fire was rejected

10/10/99 - Excavation along steep ridge revealed only top 10 feet of tires burning
- Recovered a total of 135,000 gallons of oil to date

10/14/99 - Began excavation of large silt basin for control of storm runoff
- CRWQCB issued a Cleanup & Abatement Order to PRPs

10/15/99 - Completed overhauling burning tire debris in lower canyon areas
- Recovered a total of 173,000 gallons of oil to date

10/16/99 - Commenced overhauling burning tire debris in middle canyon areas

10/19/99 - Representatives from offices of Feintein, Boxer and Condit tour site

10/24/99 - Williams completed overhauling burning tire debris in middle canyon

10/25/99 - CIWMB contractor's began construction of check dams for winterization
- Commenced overhauling burning tire debris in upper canyon areas
- Began shipments of oil to Romic Environmental Technologies

10/26/99 - A. Johnson, CIWMB, designated SOSC by Cal-EPA

10/27/99 - Conducted infrared survey to locate remaining hot spots
- Fire officially declared out by EPA FOSC at 1235
- Fire burned for a total of 36 days

10/29/99 - California legislative committee on tire disposal held meeting in Patterson

11/03/99 - Last shipment of oil to Romic Environmental
- Total volume of oil sent to recyclers was 250,950 gallons
- Federal response team demobilized all personnel and equipment
- Cal-EPA assumed lead agency role and continued winterization work

II. Summary of Events

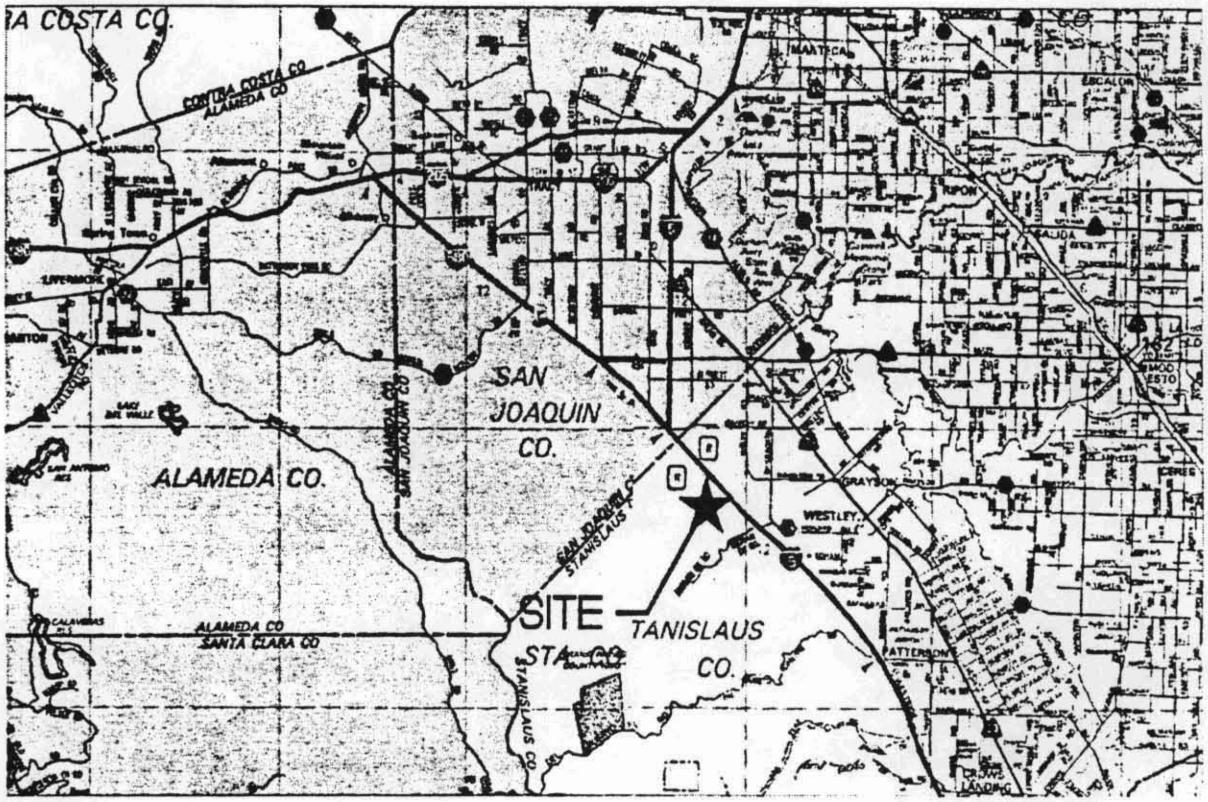
A. Situation

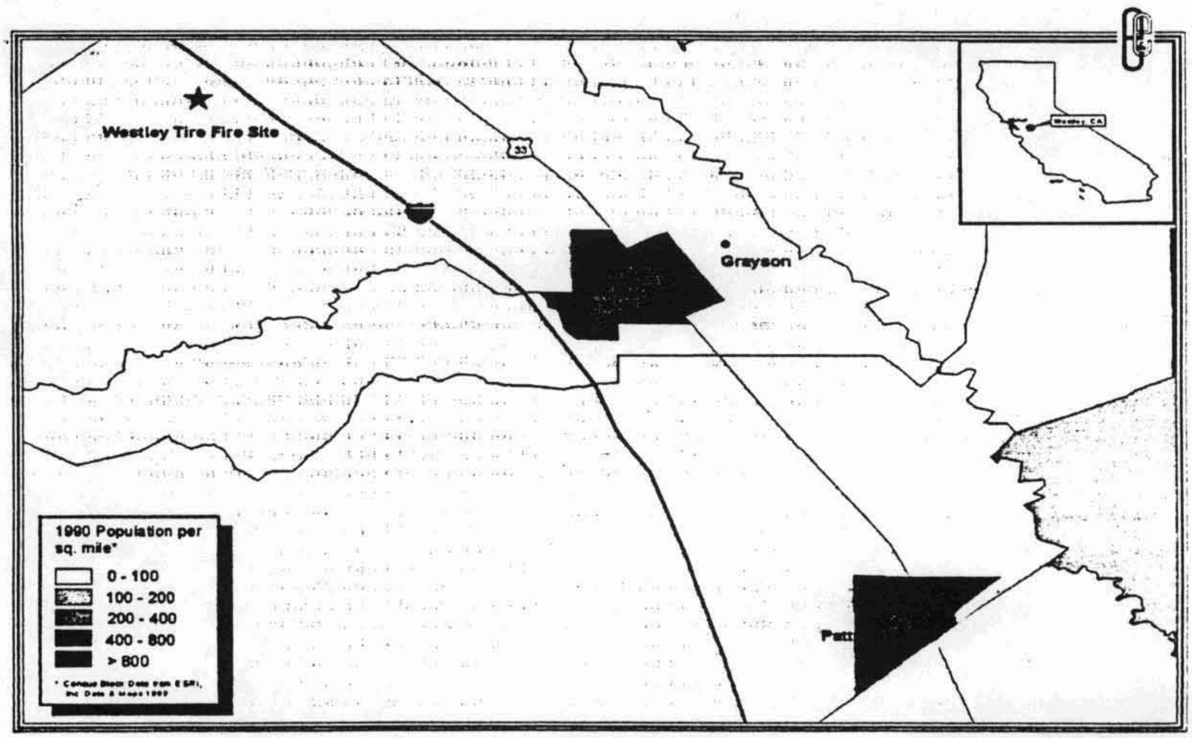
1. Background

Back in the 1950's, Edward Joseph Filbin opened a dump for scrap tires on his ranch. The dump was in a canyon where the rolling hills of the Diablo Coastal Range meets the Great Central Valley of California. The site was about 35 miles southeast of San Francisco Bay and 1/4 miles from Interstate highway 5. This was a rural farming area and the surrounding land was being used for agricultural production and grazing. As you travel up the canyon from the valley into the hills the canyon gradually became deeper, the walls became higher and steeper. Filbin dumped the tires on the very steep eastern slopes of the main canyon. The site was approximately 40 acres of which 22 acres were covered by the main tire pile that was impacted by the fire. At the time of the fire there were an estimated 5 million tires in the main tire pile. An estimated 2 million tires in separate piles were located south and southwest of the burn site and were unaffected by the fire. An unnamed intermittent stream flowed north in the drainage and under the tire pile. This stream was fed by springs and runoff from tributary drainages. Shallow ground water was encountered in the upper canyon area. There were four tributary canyons that drained approximately 800 acres of watershed. A stock watering pond and earthen dam were located in the lower part of the canyon.

By 1987 it was estimated that Filbin had accumulated 40 million tires stacked 80 feet high on the slopes. This would have made the Filbin pile the largest tire pile in the country. In 1988, Modesto Energy Limited Partnership (MELP) started-up the first tire burning co-generation power plant. The MELP power plant was built on a tall hill overlooking the tire pile. The source of tire-derived fuel was a combination of old tires from the scrap pile and new tires that were brought to the facility by contracted haulers. The heat generated by burning tires converted water into high pressure steam which drove a turbine and generator and produced electricity that was sold to a private utility company, Pacific Gas & Electric. The tire incinerator burned 18,000 tires per day, 6 million tires per year or 60% of northern California scrap tires. This provided electricity for 18,000 homes. But the reduction in the size of the pile was slow because the older scrap tires had less BTU value than the newer tires. The daily consumption of tires included only 20% old tires. The energy plant eventually reduced the pile to 7 million tires.

Filbin had constructed a road that transected the hillside above the canyon of tires. Haulers would drive to the top of the pile and dump their load on top of the pile. A steel-plated ramp was placed over the pile at the top of the canyon and was extended out over the precipice. The ramp was actually part of the runway of an aircraft carrier. The trucks would back up onto the ramp and dump over the side building up piles that were 60 feet deep. Additionally, Filbin may have buried thousands of tires in the drainage. It has been alleged that during the construction of the energy plant the hilltop was leveled and the soil was bulldozed to the bottom of the canyon to create a level surface for stockpiling the tires. The tires piled in this area were not moved and were covered by the soils removed from the top of the hill. Evidence of this was uncovered while backhoes were overhauling burning tire debris in the drainage area. Attempts by State regulators to compel Filbin to provide adequate fire protection, fire breaks and further reduction in the size of the tire pile were unsuccessful. The tire pile did not comply with NFPA guidelines which called for a minimum 60-foot wide separation between piles, not greater than 20 feet high and 250 feet in length and width.

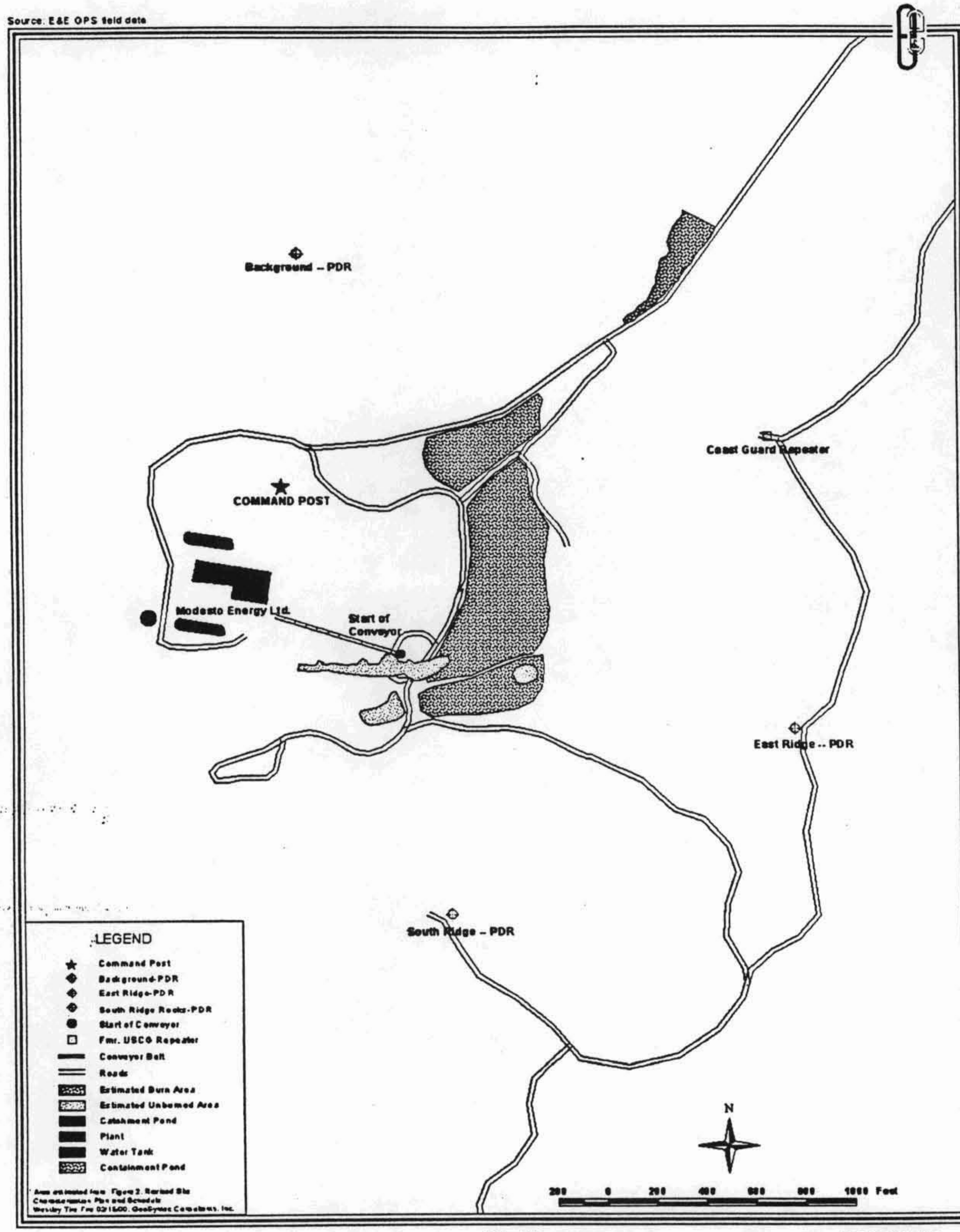




4 0 4 Miles

Area Population
Westley Tire Fire Site
Westley, California

TDD 09 9910 0001
PAN 09-0479-WTRZ-XX
DATE March 16, 2000



Site Map
Westley Tire Fire
Westley, California

TDD: 09-9910-0001
PAN: 09-0479-WTRZ-XX
DATE: March 16, 2000

2. Tire Fire Dynamics

On January 22, 1999, a rare lightning storm moved into the San Francisco Bay Area. Hundreds of lightning strikes were recorded. One lightning bolt struck the metal ramp and ignited the tires in the Filbin tire pile. The fire roared down the canyon with a 200 foot high fireball leading the conflagration. Temperatures were over 2,000 degrees F. The smoke plume formed a tornado-like vortex lifting the smoke upwards in a spiraling chimney reaching 6,000 feet in altitude. The ash and soot fallout was reported as far as 60 miles away. Rains mixed with ash and soot fell as black rain over the San Francisco Bay Area.

The Westley Tire Fire progressed through several stages that were typical of most tire fires. These were identified as the ignition/propagation phase, compression stage, and the pyrolysis/smoldering stage. The propagation phase was characterized by high open flames, high temperatures and flammable vapors. At this stage there was an incredible amount of energy released which manifested itself as a cyclonic tornado-type vortex that generated tremendous heat and winds. The smoke was lifted in a column thousands of feet into the air. During the compression stage the tires lost their rigidity, settled and began to collapse in on themselves. Both heat and smoke increased at this stage. As the tires melted down, the ash, bead wire and steel belts formed a crust layer over the pile. At this stage it was a deep seated fire, slower burning with less smoke emissions. Tires deep in the pile began to pyrolyze and oil began to flow from the bottom of the pile.

3. Potential Threats

The smoke plume contained toxic air contaminants that affected the residents and migrant workers in the area. During the early stages of the fire a climatic inversion caused the smoke plume to hang low over the valley and decreased visibility on the Interstate. The day turned into darkness as the black smoke blocked out the sun. A number of people complained of symptoms related to exposure to the smoke including headaches, vomiting, nose bleeds, breathing difficulties, seizures and coughing up blood. People with asthma and allergies suffered the most from exposure to the smoke. It was estimated that if the fire was allowed to burn it would release 141,000 pounds of benzene, a carcinogen, 70,000 pounds of polycyclic aromatic hydrocarbons (many are carcinogenic), 10,000 pounds of butadiene, a chemical linked to leukemia, thousands of pounds of carbon monoxide and particulates and trace amounts of arsenic, chromium, lead and zinc. Located nearby was the Pacific Intertie that was the central electrical grid for the Western U.S. and carried 500,000 volts. Smoke particulates that settled on the lines could cause arching and shorting out of the system putting millions of homes in the dark.

The pathway for the pyrolytic oil runoff was into the stream which flowed under Interstate Highway 5 and across a field. Downstream was the California Aqueduct and the Delta Mendota Canal. The canal flowed to a local reservoir that was a municipal water supply for the Bay Area. Infiltration of contaminants into the soil threatened the regional ground water supply. Oil was produced in the tire fire by pyrolysis - the low temperature distillation of a tire in the absence of air. The average passenger tire contained an equivalent of two gallons of oil. The Filbin tire pile contained 7 million tires or 14 million gallons of oil. For comparison, the largest U.S. oil spill was the Exxon Valdez which spilled 11 million gallons into Prince William Sound. Although vast quantities of oil were consumed in the fire there was a serious threat of oil discharge from the large tire fire.

4. Initial Notification and Response

This was a major hazardous materials incident event and most local and State emergency and environmental agencies responded to the incident. EPA received an initial report of the incident on 9/22/99 at 0900 from the California Integrated Waste Management Board (IWMB). Hundreds of State and local volunteer fire fighters responded and battled to contain the blaze. Stanislaus County set up an Emergency Operations Center (EOC), media and medical hotlines. The first responders made the decision to let it burn. The fire was too hot and dangerous to battle and the enormous volume of water needed to fight the fire would cause severe environmental damage and overwhelm the containment. The California Department of Forestry (CDF) set up an incident command system (ICS) and formed a Unified Command (UC) with the West Stanislaus County Fire Protection District (WSCFPD). On 9/23/99, the CDF declared the fire contained in the canyon and demobilize and transferred the Incident Command to the WSCFPD, the local volunteer fire department. The primary objective at this point was to maintain fire breaks around the piles and monitor. Water would be sprayed on the unburned tire piles to cool and prevent the spread of the fire into these areas. Other unaffected piles would be moved, if possible, to increase their distance from the fire. Oil runoff was contained in the existing stock watering pond located about 100 yards downstream from the fire. The Cal-EPA Emergency Response Unit hired a contractor, PARC Environmental, to begin the removal of oil from the pond. The contractor used a vacuum truck to recover the oil. The oil was transferred to 20,000 gallon Baker Tanks for temporary storage.

5. EPA Response Action

Four days into the fire the oil flowing into the creek ignited. The huge oil fire sent a tremendous amount of oily smoke into the valley. The valley was basically a great big bowl that effectively trapped the smoke. The air quality became extremely poor. The air pollution became exceedingly worse due to a climatic inversion and ground level impacts were observed. The volunteer fire department responded but did not have the capability to deal with the oil fire. The EPA FOSC deemed the situation unacceptable due to the substantial threat to public health. The FOSC initiated a federal response using delegated authorities in accordance with the National Contingency Plan (NCP) and Oil Pollution Act of 1990 (OPA). The FOSC mobilized the federal response team consisting of the U.S. Coast Guard Pacific Strike Team, Superfund Technical Assistance and Response Team (START) contractor and the Emergency Response and Remedial Services (ERRS) cleanup contractor. The FOSC began assisting in the formation of a Unified Command (UC) under the ICS. Each participating agency accepted a role in the response effort. For example, the California Air Resources Board (ARB) would conduct off-site air monitoring, Stanislaus County would handle public relations, and the IWMB would develop a winterization plan. EPA would contain and recover the oil and provide resources needed to extinguish the oil fire. To put out the oil fire, the U.S. Coast Guard recommended Williams Fire and Hazard Control out of Mauriceville, Texas. Williams was formerly part of the famed Red Adair's Boots and Coots "hellfighters". Williams had over 50 years of experience in putting out large oil fires all over the world and extinguished the oil well fires during the Gulf War. The Williams fire fighters extinguished the oil fire in two days.

B. Organization of the Response

The National Interagency Incident Management System (NIIMS) Incident Command System (ICS) is the system used by the fire service and other emergency response organizations to manage crisis response operations. NIIMS is organizationally flexible and capable of expanding and contracting to accommodate responses of varying size and complexity. It involves four functional sections which report to the incident commander - planning, operations, logistics and finance. Additionally, other functional support, such as media and public information officer (PIO) and health & safety are part of the command staff. An ICS led by a Unified Command (UC) is used to manage a complex, multi-jurisdictional response. The ICS led by a UC is recognized as the most effective method to involve local, State and Federal parties and the Responsible Party (RP) and to bring their respective expertise to the response. The UC maintains a cooperative environment, promoting overall efficiency in the emergency response. All agencies retain their authorities and responsibilities and work together to develop a common set of incident objectives and strategies, share information, maximize the utilization of available resources, and enhance the efficiency of the individual response organizations.

At the Westley Tire Fire, there was an attempt to organize the agencies into a unified command. A standard NIIMS ICS was not used primarily because the State and County governmental agencies did not follow the ICS doctrine and most were not familar with the system. However, some of the components of the NIIMS ICS were implemented. The following is a list of primary agency representatives that participated in the response. Additionally, an organizational chart provides a conceptual structure used at the Westley Tire Fire. The individual roles and functions may have changed, overlapped or elapsed over the course of the response.

AGENCY	CONTACT	RESPONSE ROLE
U.S. EPA, Emergency Response Office 75 Hawthorne Street San Francisco, CA 94105	Daniel M. Shane, Federal On-Scene Coordinator (415) 744-2286	Responsible for managing the deployment of resources and personnel, coordinating response actions with other federal, state and local agencies
U.S. Coast Guard, Pacific Strike Team Hangar 2, Hamilton Field Novato, CA 94949	CDR Paul Jewell (415) 883-3311	Health & Safety Officer Responsible for ensuring compliance with Health & Safety Plan, communications, cost documentation, ICS support
U.S. Coast Guard, National Pollution Fund Center 4200 Wilson Blvd, Suite 1000, Arlington, VA 22203	LCDR Greg Buie (202) 493-6846	Administers the OPA Oil Spill Liability Trust Fund, dispenses funds for federal oil spill response actions, manages claims and cost recovery
Commanding Officer National Strike Force Public Information and Assistance Team 1461 N. Road Street Elizabeth, NC 27909	CWO Daniel Waldschmidt (252) 331-6000	Directed by the FOSC to assist in media and public relations, town hall meetings, press conferences and photo and video documentation
NOAA Office of Response & Restoration 11th Coast Guard District Coast Guard Island, B50-5 Alameda, CA 94501	Heather Parker Hall (510) 437-5344	Scientific Support Coordinator (SSC) Directed by FOSC to provide daily weather forecasting and meteorological information
Ecology & Environment, Inc. 350 Sansome Street #300 San Francisco, CA 94104	Robin Clemens (415) 981-2811	EPA START Contractor Technical and scientific support, multi-media monitoring and sampling, polreps and documentation

AGENCY	CONTACT	RESPONSE ROLE
IT Corporation 2130 William Pitt Way Pittsburg, PA 15238	Richard Fisher, Response Manager (412) 826-3319	EPA ERRS Contractor Prime contractor with overall responsibility for mobilization of equipment and supplies, fire suppression activities, cleanup and disposal operations
Williams Fire & Hazard Control, Inc. P.O. Box 1359 Mauriceville, Texas 77626	Dwight Williams (800) 231-4613	ERRS Subcontractor Lead Fire-fighter, responsible for extinguishing the tire fire
Ecology Control Industries 255 Parr Blvd Richmond, CA 94801	Karen Bluitt-Ruffin (510) 970-7463	ERRS Subcontractor Responsible for oil containment, recovery, storage, transportation, disposal and recycling
California Department of Forestry and Fire Prevention 15670 Monterey Street Morgan Hill, CA 95037	Carl Burton (408) 779-2121	Initial First Responder State Incident Commander Responsible for set up of ICS, fire control & containment
Cal-EPA, Integrated Waste Management Board 8800 Cal Center Drive Sacramento, CA 95826	Ralph Chandler, State IC (916) 255-2182 Albert Johnson, SOSC (916) 255-3840 Todd Thalhamer (916) 255-1194 Robert Fujii (916) 255-1300	State Representative to the Unified Command. Primary regulatory authority over the tire pile, developed and implemented site winterization and tire remediation projects, provided on-site technical expertise in tire fire suppression and site remediation techniques
Californial Regional Water Quality Control Board 3443 Routier Road, Suite A Sacramento, CA 95827	Wendy Arano (916) 255-3137	Responsible for surface and groundwater protection, treatment and disposal of fire-fighting water, initiated enforcement action against PRPs
Cal-EPA, Department of Toxic Substances Control, Emergency Response Unit P.O. Box 806 Sacramento, CA 95812	Karl Palmer (916) 323-3658 Sam Martinez (916) 323-3516	Mobilized initial response to oil spill. Hired contractor to pump and store oil runoff. Responsible for waste classification and assisting in the recycling of oil
Cal-EPA, Air Resources Board P.O. Box 2815 Sacramento, CA 95812	Jim Morgester (916) 322-6022	Responsible for off-site air surveillance program and evaluation of air impacts to surrounding communities
California Department of Fish & Game, Office of Spill Prevention and Response P.O. Box 944209 Sacramento, CA 94244	Kim McCleneghan (916) 322-9210	Provided on-site technical assistance. State Resource Trustee, characterized impacts of runoff on fish and wildlife.
California Office of Emergency Services P.O. Box 419047 Rancho Cordova, CA 95670	Tracey Vardas (916) 464-3287	Responsible for overall coordination of State agencies. Monitored response and reported to the Governor's Office.

AGENCY	CONTACT	RESPONSE ROLE
Stanislaus County Office of Emergency Services 1100 H. Street Modesto, CA 95354	Chief Russell Richards (209) 558-6453	Responsible for directing EOC operations and coordinating local fire department resources in support of the response
Stanislaus County Department of Environmental Resources 3800 Cornucopia Way, Suite C, Modesto, CA 95358	Jim Simpson, Local IC (209) 525-6753	Local representative to the Unified Command. Responsible for public relations, media/public hotlines and website. Provided general response support
Stanislaus County Department of Public Works 1100 H Street Modesto, CA 95354	George Stillman (209) 525-7547	Provided office trailer for use as a command post, office equipment and utility hook-ups.
Stanislaus County Executive Office	Reagan Wilson, CEO (209) 525-6333	Coordinated overall local response efforts, facilitated multi-agency and town hall meetings, served as a primary spokesperson for the media
West Stanislaus County Fire Protection District P.O. Box 565 Patterson, CA 95363	Chief Richard Gaiser (209) 892-5621	Initial first responder Local Incident Commander Responsible for control and containment of fire during night time hours
Modesto Energy Limited Partnership/UAE Energy Operations Corp.	John Brown, RP IC (209) 894-3161	Responsible Party representative to the Unified Command. Responsible for site security, water supply, and general support to the UC

UNIFIED COMMAND

(Federal, State, Local, RP)

- **Public Affairs** (County)
- **Safety Officer** (USCG)
- **Technical Support**
  - IWMB
  - DFG/OSPR
  - NOAA SSC

- **Operations/ Planning** (EPA)
- **Logistics** (EPA)
- **Finance** (EPA)

Operations/ Planning (EPA)

Hazmat Group (EPA/ERRS)

- contain and recover pyrolytic oil (ECI)
- excavate and overhaul burning tire debris (IT Corp)
- manage fire-fighting runoff water (ECI)
- waste classification & oil recycling (DTSC)
- procure, repair & maintain heavy equipment (IT Corp)
- transportation and disposal (ECI)
- equipment decontamination (IT Corp)
- site security (MELP, IT Corp)

Fire Suppression Group (Williams/WSCFPD/CoOES)

- extinguish oil fire (Williams)
- extinguish tire fire (Williams)
- establish adequate supply of water & foam (IT Corp)
- operate delivery system to extinguish fires (Williams)
- provide rescue & medical capability (IT Corp)
- provide "night watch" (WSCFPD)
- coordinate local fire resources (CoOES)

Environmental Monitoring & Assessment Group (EPA/START)

- on-site air monitoring (START)
- off-site air monitoring (ARB)
- waste sample collection and laboratory analysis (START)
- assess impacts to surface water & groundwater (RWQCB)
- infrared survey (IWMB)

Winterization Group (IWMB)

- construct dams and water diversion (IWMB/NORCAL)
- construct large silt basin (EPA/IT Corp)
- develop erosion control plan (START/Ninyo & Moore)
- recontour & hydroseed slopes (IWMB)
- treat and dispose of wastewater (RWQCB)

Remediation Group (DTSC/IWMB)

- remediate unburned tire piles (IWMB)
- conduct site characterization (DTSC)
- remediate burn site (DTSC)
- review work plans (DTSC, IWMB, RWQCB, EPA)

C. Fire Suppression Tactics

The initial fire suppression strategy was to extinguish the oil fire, prevent re-ignition of the oil fire and reduce smoke emissions as much as possible without endangering the responders. Williams quickly extinguished the oil fire in two days. For the flammable liquid fire fighting Williams used a Daspit Tool, a new monitor on legs developed by Williams that was capable of flowing up to 500 gpm of water and foam solution. A 3M Light Water AFFF/ATC proportioned at 3 percent was used for the attack on the hydrocarbon fire. The oil in the drainage continued to boil and AFFF was re-applied to place a foam blanket and control vapor emissions to reduce the possibility of re-flash. A buffer or cooling zone was created by removing burning tires from the stream in the lower canyon up to the first steep slope. The burning tires were moved by excavators to work areas that were leveled on both sides of the stream. The smoldering debris was spread out over the area in thin lifts by the dozers and doused with water and foam. Thousands of buried tires below the streambed were encountered and had to be excavated. Buried tires were encountered to a depth of more than 25 feet below grade. A pit was deepened above the road culvert to catch oil flowing from the tire pile. A 30 foot length of ten inch pipeline was installed below the culvert in the streambed to convey oil to the retention pond. Should the oil flowing from the pile re-ignite, the flow of oil through the pipe would encounter an oxygen deficient atmosphere and be snuffed out and cooled before entering the pond. Burning tires on relatively level areas in the lower part of the canyon were extinguished up to the first steep slope further reducing smoke emissions.

During this phase there was constant re-assessment of tactics that could be used to attack the fire in the deepest portion of the tire pile located on the slopes. The slopes were very steep and unstable, tires were collapsing under extreme temperatures. The large quantities of water that would have to be applied to extinguish the fire could overwhelm the containment structures and produce millions of gallons of contaminated water runoff that would have to be removed. Additionally, EPA's past experiences with using water and foam extinguishment methods on large tire fires proved unsuccessful. The public was very critical of any decision that called for letting the tire fire burn itself out and emit toxic smoke for years. The FOSC had the ultimate responsibility for the safety of the response workers. No decision would be made to send in personnel and equipment into the high danger areas until the FOSC was convinced that it could be done safely and effectively. The fire-fighters continued to extinguish burning tire debris in relatively safe areas below the steep slopes of the hillside.

As Williams approached the first slope the excavator operatior dug along the outer fringe of the burning pile to explore how far the fire had progressed into the pile. It was discovered that the fire had penetrated only 7-10 feet into the pile. The FOSC surmised that the reason why only the top of the pile was burning was because the tires were piled on steep slopes allowing the oil to flow away from the seat of the fire. This resulted in a much slower burning pile because the fire was being robbed of fuel. Under these circumstances it would be reasonable to predict that the tires would continue to burn for many years at this rate since there were millions of unburned tires remaining in the pile. Armed with this information, a fire-fighting strategy was developed for separating and extinguishing the top layer of burning tires.

Fighting the fire on the slopes required the largest heavy equipment that could be found. This included giant excavators, long-stick trackhoes with 70-foot reach, tracked dozers, front-end loaders and end dump trucks. Williams brought in larger pumps and Daspit tools that were portable and mounted on trucks. Several 2000 gpm monitor guns were used to attack the fire from the bottom and top of the canyon. Williams used a new foam on the market, 3M SFFF, to penetrate and extinguish the 3-dimensional deep seated fires. This foam had the ability to greatly reduce the surface tension of water which allowed it to penetrate quickly to the seat of the fire for effective extinguishment. The ridge team used large volume high pressure monitors to "hydro-mine" the burning debris and wash it down the steep slopes to the excavators. The excavators would pick-up and toss the burning debris in the air while the ground team doused the debris with foam. The Komatsu 1100 "Big Girl" would move the smoldering debris to the bottom of the hill. The Komatsu literally moved mountains of burning tires and debris in a safe and effective manner. A ground team using long-stick trackhoes reached across the stream and loaded debris into their buckets. The hot debris was quenched in slurry pits that had been dug into the streambed. It was very important to submerse the debris in water because the wire and steel in the melted tires were still very hot. In fact, a small fire was re-ignited in a large debris stockpile by hot steel that was not quenched prior to removal. The quenched debris was loaded into end dumps and hauled to several stockpiling areas. The local volunteer fire department was subcontracted to provide a night watch to contain the fire so that it did not spread back into areas previously extinguished during the day. The fire was totally extinguished in 27 days. A total of 38,000 gallons of foam were used at a cost of $607,000.

D. Managing Runoff

All oil and water runoff was successfully contained behind the earthern dam. Only once did the runoff threaten to overwhelm the containment. Upon returning to the site the next morning it was observed that excessive amount of water had flowed into the pond and the floating oil layer was only 2-3 inches from the overflow and in danger of overtopping and discharging to the down stream side of the dam. To deal with the problem, a waste water recycling system was improvised. A large pump was installed at the pond and water was pumped below the floating oil layer uphill through 3,000 feet of 5 inch fire hose to the power plant's one million gallon capacity cooling water lagoon Another pump was located at the lagoon and water was pumped downhill to the monitors. Fire-fighting water runoff flowed down the slopes and downstream to the oil retention pond. This recycled waste water was continuously re-circulated in this manner. Later testing of the waste water revealed that this system accelerated the vaporization of dissolved volatile organic compounds (VOCs) in the re-used water. Vacuum truck operators worked all day to skim oil off the surface of the pond. The oil was transferred to 20,000 storage tanks. Approximately 80 percent of the oil generated by the fire occurred within the first 10 days. Once the optimum conditions for pyrolysis were reached oil flowed at a high rate in a short period of time. On-site air monitoring detected the highest total VOCs at the pond. The use of Level C personal protective equipment was mandatory when working in this area.

E. Disposal of Pyrolytic Oil

Early in the response the FOSC directed ERRS to research disposal options for the pyrolytic oil. START collected oil samples from the tanks. The oil samples were submitted to an analytical laboratory to determine the composition and physical properties of the oil. Additionally, Cal-EPA/DTSC collected samples for the purpose of waste classification. The EPA analyses indicated the pyrolytic oil was similar in composition to used crankcase oil. The volatile organic compound (VOC) concentrations were higher in the pyrolytic oil but comparable to the VOC concentrations in many fuel oils. The metal concentrations in the oil were below regulatory threshold levels. Additionally, the heating value of the pyrolytic oil was 17,000 BTU's per pound which was between the heating values of coal and #6 Fuel Oil. The following table shows the oil composition of pyrolytic oil in comparison to used oil:

PYROLYTIC OIL	USED CRANKCASE OIL
Benzene 880 ppm	Benzene 20 ppm
Toluene 2600 ppm	Toluene 380 ppm
Xylene 2100 ppm	Xylene 550 ppm
Napthalene 710 ppm	Napthalene 330 ppm
Lead 3.4 ppm	Lead 240 ppm
Zinc 830 ppm	Zinc 480 ppm
Flashpoint 120 F	Flashpoint > 140 F

Based on these results, EPA directed ERRS to focus their effort on recycling the oil. Some of the recycling options considered included sending the oil to: a petroleum refinery for re-processing into a fuel oil product; an authorized oil recycler for blending into a supplemental fuel; a tire manufacturer for use in making new tire products and; an asphalt plant to use as an oil supplement in making asphalt products. The FOSC's preference was to send the oil to a local refinery for re-processing into a petroleum product. This was how other EPA regions had dealt with the pyrolytic oil from tire fires. A small local refinery, Huntway Refinery in Benecia, CA, indicated an interest in taking the oil at no cost.

Cal-EPA notified the FOSC that their analyses indicated that the oil would have to be classified as a "hazardous waste" under California hazardous waste regulations. The classification was based on the oil exceeding the State regulatory threshold levels for benzene, ignitability and aquatic toxicity. The oil failed the 96-hour fish bioassay test. These levels were not unusual for many recycled petroleum products. The FOSC requested Cal-EPA to grant a one-time emergency permit to the refinery. Cal-EPA would not grant the permit. The basis for not issuing the permit remains unclear. Under Cal-EPA regulations, DTSC may issue emergency permits to a non-permitted facility when there is an imminent and substantial endangerment to human health or the environment (CCR, Title 22, § 66270.61). The situation at the site became critical due to lack of storage tank capacity. Using emergency authority under the NCP, the FOSC transported 60,000 gallons of oil to Evergreen Oil Company in Newark, CA. Prior to the oil shipment, a sample was provided to Evergreen. Evergreen tested the oil and found it to be acceptable under the conditions of their permit. The oil was manifested as "Used Oil, Non-RCRA Hazardous Waste". Further shipments of oil to Evergreen were halted after Cal-EPA began enforcement action against Evergreen for violation of their permit for accepting the pyrolytic oil.

Cal-EPA recommended three oil recyclers in California who were authorized to take the oil - Safety Kleen, San Jose, CA, Demmeno Kardoon, Comptom, CA and Romic Environmental Technologies, East Palo Alto. Safety Kleen was not interested, Demenno Kardoon was facing major enforcement action. Romic became the selected oil recycler by default. Romic charged $0.96 per gallon for recycling the oil. The total cost was $1.08 per gallon including transportation. EPA manifested the oil to Romic as "RQ Waste Flammable Liquid N.O.S. (RQ benzene)". Romic re-manifested the oil at their East Palo Alto facility and transported the oil to the Port of Redwood City. The oil was then transferred to rail cars and shipped to Fedonia, Kansas. There, the oil was transported to the Systech Cement Kiln and used as a supplemental fuel source in the manufacturing of cement. EPA removed over 250,000 gallons of pyrolytic oil. The total cost for recycling the oil as a blended fuel source was over $250,000. By comparison, there would have been no cost for recycling the oil as a feedstock material (product) for petroleum refining, excluding transportation.

F. Air Monitoring and Surveillance

The California Air Resources Board (ARB) deployed significant resources to assist the UC by conducting off-site ambient air monitoring of pollutants in the smoke plume and better understand the impacts to nearby residents. The ARB conducted 24-hr surveillance and air monitoring from September 22 to October 27. The ARB deployed the "Rover" air monitoring station which has extensive monitoring capabilities, including criteria and toxic air pollutants. Additionally, ARB set-up fixed air monitoring stations at six sites in several communities as requested by the UC. The National Atmospheric Release Advisory Center at the Lawrence Livermore National Lab was requested to perform plume modeling and predict the winds, the dispersion and deposition of smoke from the fire. Air monitoring station results indicated downwind ambient concentrations of carbon monoxide and total hydrocarbons were essentially zero during the fire. A comparison of total carbon and average PM10 particulate concentrations during the height of the fire indicated that the fire smoke had little impact on the particulate levels at the sampling sites. However, there were concentration spikes where exposure to ground-level smoke caused short-term impacts. Many local residents reported adverse health effects from periodic ground-level impacts by the smoke.

In addition to off-site air monitoring, EPA and ARB conducted on-site air monitoring and and collected air samples. On September 23, the EPA START contractor collected two SUMMA cannister samples of the smoke in the fire plume. The ARB analyzed the samples and found 570 ppb and 338 ppb butadiene, and 930 ppb and 557 ppb of benzene, respectively. For comparison, the OSHA Permissable Exposure Levels (8-hr average) for butadiene and benzene are 1000 ppm and 1 ppm, respectively. On September 29, the FOSC directed START to analyze the vapor emissions from the oil containment pond to determine the appropriate level of protection for workers. There were very strong noxious odors eminating from the pyrolytic oil collection area. START subcontracted Air Toxics, Inc. to provide a mobile lab for volatile organics (mass spec/TO-14). The maximum concentrations detected were toluene (520 ppb), ethylbenzene (395 ppb), benzene (270 ppb) and m,p-xylene (260 ppb). The ARB also performed a pyrolytic oil headspace analyses on October 25. The analytical results indicated three hydrocarbon compounds represented 55 percent by volume of total hydrocarbons detected. The hydrocarbons were 2-methylpropene (isobutylene), benzene and toluene. During the time period of October 6-10, START collected samples with personal pumps to characterize airborne concentrations in the hot zone and determine the adequate level of personal respiratory protection. The samples were analyzed for polycyclic aromatic hydrocarbons (PAHs), volatile organic compounds (VOCs) and metals. Results for all samples were below the OSHA permissable exposure limits.

G. Site Winterization

After the fire was nearly extinguished, there was a transition period where U.S. EPA transferred the lead agency role to Cal-EPA. Cal-EPA designated Albert Johnson, IWMB, as the State On-Scene Coordinator (SOSC). The IWMB immediately mobilized their contractor, NORCAL, to begin site winterization activities. The governmental agencies were concerned that California could experience an El Nino season involving heavy winter storms that could generate significant runoff problems. Runoff from the 800 acres of watershed could deluge the site, overwhelm the existing containment structure and mix with the contaminated soil and ash. High volumes of essentially a contaminated slurry would create disposal problems. The IWMB geotechnical engineers developed a plan to impound runoff water in several tributary canyons and build pipelines that would convey the water through the site and discharge downstream. The contractors constructed small coffer dams in two of the largest tributaries and two nearly mile long above-ground pipelines to transport clean water impounded behind the dams to a discharge point below the contamination zone.

EPA provided assistance to IWMB by completing two major projects prior to demobilization. IT Corp was directed to construct a large silt basin upstream of the final retention pond. The silt basin would act as a sediment and debris trap and prevent oil and other contaminants from flowing into the final pond. The narrow drainage way was filled with soil. The soil plug served as a dam structure for the silt basin. A pipe was laid through the plug and a gate valve was installed on the basin side of the pipe. In this way the water level in the silt basin could be controlled. Additionally, Ninyo & Moore, a geotechnical & environmental science consultant for START, developed an erosion control plan which was implemented by the IWMB. The slopes were re-contoured and hydro-seeded to reduce erosion. Additionally, the surrounding hills that were impacted by the grassland fire were hydro-seeded.

It was estimated that 4 million gallons of fire-fighting water were impounded on site. This water needed to be removed to provide sufficient capacity to hold back winter storm water runoff. The cost for hauling, treating and disposing of such a large volume of contaminated water at an off-site facility would have been significant. The FOSC recommended that the water be tested and, if acceptable, used as make-up cooling water at the MELP power plant. The RWQCB collected and analyzed samples of the waste water. The RWQCB analytical results indicated that the waste water was not hazardous and acceptable for use at the plant. The MELP plant was re-started and millions of gallons of waste water were pumped to the plant's cooling water storage lagoon. Sand and carbon filtration units were used to treat the water to reduce the suspended solids and VOC's to acceptable levels for use in the cooling towers and to comply with their air permit. In this process, the energy plant mitigated a significant fire hazard by burning an estimated 800,000 scrap tires that were not involved in the fire.

H. Assessment of Contamination in Ash, Debris and Runoff

On October 13 and 26, START members collected ash samples to characterize waste burn materials in order to evaluate disposal plans and is case of a release. The ash samples were analyzed for volatile organics, semi-volatile organics, total and soluble metals, pH and total recoverable petroleum hydrocarbons (TRPH). One ash sample was a mixture of ash and debris and the other sample was mainly composed of ash. Generally, lower concentrations of contaminants were found in the ash/debris sample as compared with the pure ash sample. Low concentrations of volatile and semi-volatile compounds were detected in the samples. The highest concentrations were benzoic acid (16 mg/kg), 2-methylnapthalene (2.3 mg/kg) and para-isopropyl toluene (2 mg/kg). Low concentrations of metals were detected in the samples with the exception of zinc. The zinc (total) concentrations ranged from 880 to 11,000 mg/kg. The Total Threshold Limit Concentration (TTLC) for hazardous waste containing zinc was 5,000. The EPA's Preliminary Remediation Goal (PRG) for zinc in residential areas was 22,000 mg/kg. The zinc (soluble) concentrations ranged from 40 to 81 mg/l. The Soluble Threshold Limit Concentration (STLC) for hazardous waste containing zinc was 250 mg/l. The ash pH ranged from 8.2 to 8.4. The ash residues contained high concentrations of TRPH which ranged from

1,800 to 36,000 mg/kg.

On September 22, START members collected a fire-fighting water sample from the ditch downstream of the burning tire piles. The samples were collected to establish a baseline for future sampling and at the time the samples were taken there was no oil sheen on the water. The samples were analyzed for volatile organics, semi-volatile organics, priority pollutant metals and total extractable hydrocarbons (diesel range). Low concentrations of volatiles, semi-volatiles and metals were detected in the sample. The highest concentrations of volatiles were 4-methyl-2-pentanone (1200 ug/l), acetone (460 ug/l) and 2-butanone (250 ug/l). The highest concentrations of semi-volatiles were benzoic acid (7,100 ug/kg), phenol (2,600 ug/l) and 2-methylphenol (800 ug/kg). The highest concentration for metals was zinc (8,300 ug/l), . The concentration for diesel C10-C24 was 28,000 ug/l.

On October 13, START members collected a sample of the fire suppression water being recycled back to the general water supply. The samples were analyzed as before. There was a substantial increase in the concentrations of contaminants detected during the first sampling event. Additionally, new contaminants were detected. The highest concentrations of volatiles were acetone (9,800 ug/l), 2-butanone (1,800 ug/l) and benzene (1,000 ug/l). The highest concentrations of semi-volatiles were benzoic acid (380,000 ug/l), phenol (19,000 ug/l) and 2-methylphenol (6,900 ug/l). The highest concentration for metals was zinc (55,000 ug/l). The pH was 6.8. The TRPH concentration was 20,000 ug/l. As the the fire-fighting water re-circulated through the system there was a significant reduction in the concentrations of organics and metals. On December 6, the DTSC conducted sampling of the waste water stored in unlined retention ponds for the purpose of waste classification. The water was determined to exhibit non-hazardous characteristics. Upon this determination, MELP commenced pumping waste water from three ponds to MELP's cooling water lagoon, a permitted Class II lined impoundment. MELP proceeded to utilize the water in the cooling tower, thereby speeding the reduction of volume in their pond via evaporation. On 31 January, 2000, MELP closed the plant and no longer could utilize the waste water in the tire burning operations. MELP contracted for the removal and off-site disposal of remaining contaminated storm water that was pumped to the lined impoundment. The RWQCB approved the disposal of waste water at Anadime's Oxnard Class II Fluids Disposal Facility. The Anadime plant is licensed for commercial Class II N.O.W. (Non-hazardous oilfield waste) disposal. Anadime utilizes Slurry Injection Technology for deep well disposal of Class II fluids. Approximately 1.2 million gallons of waste water were removed during February through 17 March, 2000.

I. Resources Committed

1. <u>Estimated Cost</u>

This is the estimated cost of the emergency response action and may not include all costs to date. EPA's total project cost ceiling was $5 million. The cost of the response action is summarized below:

	Estimated Costs:	Cost Ceilings:
ERRS Contractor:	$ 3,500,000	$ 3,868,000
Government Costs:	200,000	
U.S. EPA		
U.S. Coast Guard		
START		
Federal Total:	$ 3,700,000	
State Costs:	827,000	
MELP Costs:	1,000,000	
Grand Total:	$ 5,527,000	

{Estimated Remediation Cost: $10 to $22 million}.

2. Personnel Resources

Federal (6)

1 EPA On-Scene Coordinator
4 - U.S. Coast Guard Pacific Strike Team Members
1 - U.S. Coast Guard Public Information Assistance Team Member

Federal Contractors (28)

4 - Superfund Technical Assistance & Response Team Members (E&E)

24- Emergency Response & Remediation Services (IT Corp.)

- 1- Response Manager
- 1- Foreman
- 1 - Health & Safey Techician
- 11- Equipment Operator/Clean-Up Technician
- 3- Truck Driver
- 1 - Pump Operator
- 4- Oil Recovery (ECI)
- 2- Field Clerk

Williams Fire & Hazard Control (14)

- 1- Lead Fire Fighter
- 1- Operations Manager
- 8- Fire-Fighters
- 1 - Pump Operator

2 - Equipment Operator
1 - Breathing Air Tech/Safety

West Stanislaus County Fire Protection District (6)

6- Fire-Fighters

TOTAL PERSONNEL: 54

3. Equipment Resources

1- 4000 GPM Pump
2- 2000 GPM Pump
1- Rain-For-Rent Pump
1- 2000 GPM Hired Gun
1- 2000 GPM Daspit Skid Mounted
1- 5600 feet of 5" Hose
1- 2950 feet of 3" Hose
1- 3000 feet of 1 ½" Hose
1- Lot Breathing Air Equipment
6- 3800+ Gallon Vacuum Trucks
1- Komatsu Excavator PC-220LC
1- Komatsu Excavator PC-220LC EX
1- Komatsu Excavator PC-1100CL
1- Kamatsu Excavator PC-600
1 - Catepillar 245 Excavator
1- Catepillar 330 Excavator
4- Catepillar 375 Excavator
1- Kamatsu Crawler Dozer DZR525
1- Catepillar Dozer D6R
1- Catepillar Dozer D9R
1- Catepillar Dozer D10R
1- Catepillar Dozer D155
1- Catepillar Dozer D375A
1- Catepillar Dozer D65PX-12
1- Catepillar D10N Track Type Tractor
2- Komatsu Wheel Loader WLA430
1- Catepillar Loader 988
1- Catepillar Loader WA600
3- Catepillar D400E Articuated Dump Truck
2- Catepillar D350E Articulated Dump Truck
1- Catepillar 815F Compactor
1- Catepillar Compactor 54"
2- Catepillar TH-83 Telescopic Forklift
12- Baker Storage Tanks 20000 Gallon
1- Water Truck 4000 Gallon
1- Towable Light Tower

1- Decon Trailer 8x20
1- Air Compressor
2- Office Trailers 10x40
1- Williams' Equipment Storage Trailer
1- Williams' Emergency Response Trailer
1- 50000 Gallons Fire-Fighting Foam

III. Lessons Learned

A. Key Lessons Learned

Incident Command System/Unified Command

1 Environmental and pollution response personnel from federal, state and local agencies need training in ICS/UC.

2. State needs to designate a lead agency and identify the IC for off-highway oil and hazardous material incidents.

3. State and local Incident Commanders should be persons that are empowered to make decisions and commit resources on behalf of their agency.

4. The incident should be managed by the UC in the field.

5. Joint decisions made by the UC should not be changed or circumvented by agencies not participating with the UC in the management of the emergency.

6. State and local agency personnel with ICS responsibilities must be able to disengage from normal duties, and be present on a daily basis to expedite issues critical to the UC.

7. The ICS should not disband following the transition from the emergency to the remediation phase unless there is consensus by the UC that it is no longer needed.

Federal, State and Local Coordination

1. Local agencies stressed the importance of having a full blown multi-agency meeting very early in the response to provide an overview of the incident and discuss coordination issues.

2. Local agencies would benefit from a knowledgeable Liaison Officer who can explain the relationship between local, state and federal resources and authorities. Local agency representatives stated that they never did figure out how the Federal EPA got requested or dispatched to the scene.

3. Local agencies stated a need for more key meetings or conference calls with state and federal representatives at the policy level, periodically through the response.

4. A State regulatory specialist should be on-scene to resolve waste classification, waste management, emergency permits and other regulatory issues and ensure they are given high

priority by their management.

5. EPA needs to provide better training to State and local agencies on the requirements for obtaining reimbursement of response costs through the Claims or Pollution Removal Funding Authorization process after an oil spill incident.

6. Need to use existing emergency response coordinating committees to improve response and coordination between federal, state and local agencies during major inland oil and hazardous material incidents.

7. Need to establish operational guidelines for all agencies that will likely participate on a large response or be called upon for assistance.

8. All agencies with statutory or jurisdictional authority for environmental emergencies should work together to pre-plan the early stages of the response by pre-scripting the initial actions to some degree.

9. The early pre-planning process should involve the development of an ICS/UC for oil and hazardous material spills and a short-list of generalized objectives that will guide a large organization and drive the response in the right direction.

10. The pre-planning process should consider preassigned responsibilities and other ways to speed up the response and ensure the response organization will be cohesive, effective and sustained.

<u>**Fire Suppression Tactics**</u>

1. The use of portable high pressure, high volume monitors working in tandem with large excavators to overhaul burning tire debris can be effective, but costly.

2. Bringing in a technical specialist such as Williams Fire and Hazard Control was the best thing that could have happened on this response. An excellent working relationship developed between the OSC, Williams and the contractors.

3. The Fire Suppression Group should consider the pros and cons of different fire suppression strategies. The evaluation process should be documented to enable the command to communicate the basis for implementing a specific strategy.

4. Each fire-fighting strategy should take into account safety, effectiveness, resources, cost, duration, health and environmental impacts.

5. Fire suppression using water and foam will generate a large volume of oil and water runoff that has to be contained and managed. Large tire fires may require the construction of a large diking system, dams and retention basins.

6. The waste water re-circulation system worked well in recycling and conserving fire-fighting water for reuse and preventing overflow to the containment pond. Also VOCs were reduced to non-hazardous levels by volatilization.

7. The William's patented portable monitors rated at 2000 gpm were crucial to the successful suppression of the tire fire and provided a safety cushion for personnel working in the fire zone.

8. A new foam product from 3M Company, SFFF (Class A Foam), proportioned at 1% was notably superior to other products.

9. The use of a 30 foot section of 10 inch diameter steel pipe to convey burning pyrolytic oil to the containment pond was effective in snuffing out the flames and cooling the oil before it entered the pond.

10. The quantity of foam required to extinguish a large tire fire may not be available locally. The logistics of sustaining a continuous supply of foam could turn into a monumental task.

11. The use of quenching ponds to cool debris containing hot wire and steel was crucial for preventing secondary fires in the debris stockpiles.

12. Heavy equipment will sustain significant heat damage and maintenance/repair costs will be high.

13. Resist public pressure to use or demonstrate vendor products. An emergency response action is not the time to test a new product. Hold a foam demonstration work shop to test and evaluate new foams on the market.

Public Relations

1. Establish a Joint Information Center (JIC) on-scene to control the flow of information. This will enable the Unified Command to provide accurate information from a single source.

2. Press conferences should be a joint effort of the Unified Command. This sends a message of unity and governmental agencies working together to mitigate the effects of the incident.

3. The media needs to be controlled, and their needs addressed. Press conferences and photo opportunities should be scheduled at a set time, place and duration.

4. Trained community relations specialists are needed to address serious concerns of the community during and after the event.

5. Fact sheets should be prepared by experienced community relations specialists and distributed to the public as often as necessary.

6. Professionally trained facilitators would be an invaluable asset in arranging and moderating community meetings.

7. An incident-specific Web-site would greatly enhance the Unified Command's ability to keep the public and the media informed on the response actions being taken to abate, mitigate and cleanup the spill.

8. There are risk communication specialists that can be called upon to assist the Unified Command in preparing statements that address public health concerns in non-technical terms. This would help in the building of trust between the community and the government.

Health & Safety

1. Fire-Fighters need to be equipped with Air-Purifying Respirators (APRs) and use them when there is a potential for exposure through inhalation of hazardous air pollutants. Tire fires emit toxic smoke.

2. Personal air sampling pumps should be used during an entire work shift to evaluate actual exposures to workers in the fire zone. The pumps should be placed on the worker and positioned near the breathing zone to collect the data necessary to evaluate the adequacy of personal protective equipment.

3. Development of a unified Site Safety Plan provided uniform and consistent safety policies and procedures for the response.

4. Daily tailgate safety meetings attended by all personnel helped identify potential safety concerns from all operational areas. The usefulness of full-blown daily safety meetings to stress proper safety procedures cannot be overstated. I am convinced that these meetings were taken very seriously and as a result there were no injuries during the response which involved very dangerous operations over of span of 27 continuous days.

5. The utilization of Coast Guard Strike Team members as safety monitors inside the exclusion zone contributed to a safe operation.

Regulations, Policy and Research Needs

1. The State of California Hazardous Materials Incident Management and Oil Spill Contingency Plans need to revised to make them more consistent with SEMS and ICS.

2. The State of California needs to develop an official policy that requires supporting departments such as those involved with regulatory and permitting issues to suspend normal duties and provide immediate assistance and resources when requested by the Unified Command during a major oil or hazardous materials incident.

3. Need to develop regulations for a fire plan for sites over 100,000 tires. Create a national inventory of sites and evaluate public health and environmental risks. For the plan to be of value it must distinguish tire fires as a unique multi-category event containing the elements of a major fire, hazardous materials release and oil spill discharge combined into one event.

4. Need to develop and publish guidance on tire fires and post on a Web-site. General information needs to be accessible to local governments and fire departments within minutes. Information on chemical exposure, chemical constituents of ash, pyrolytic oil and smoke, types of foam, suppression techniques, qualified contractors, etc. need to be accessible from a central source of information.

5. Need to conduct more research to define the actual constituents of tire fire smoke during the free burning and fire suppression phases to better predict chemical exposures.

6. The Uniform Fire Code needs to be revised to prevent spread of fire from one pile to another. Currently, it recommends maximum pile separation distance of 60 feet and maximum height of 20 feet for piles that are 250 feet in length and width. Experience at recent tire fires indicated that pile separation for this size of a tire pile should be at least 200 feet.

7. A tire fire conference should be held to examine the numerous issues and problems at a tire fire. Bring in local, state, private and federal representatives from around the country and islands and discuss protocols, review literature and look at pros and cons.

8. Federal and State government should co-sponsor a Foam Technology Workshop and test other foams/suppressants. There are numerous vendors with potentially good products and others (snake oil salesman) that claim they have the magical sauce that will suppress a tire fire. An approved foam product schedule list (similar to EPA's dispersant product schedule list) should be established for quick decision making.

9. Lamar University in Texas holds an annual Foam Conference. If tire test burns could be evaluated for emissions and new suppression technology, we might be able to provide some key information to local governments and fire departments

B. Problems Associated With Multi-Agency Response and Coordination in California

This is a discussion on the problems with response and coordination in the State of California using for an example the Westley Tire Fire. The problems experienced at the Westley Tire Fire are not new and similar type problems occurred at previous large scale oil and hazardous material incidents such as the Cantara Loop Train Derailment, Santa Clara River Oil Spill, Cajon Junction Train Wreck and others.

There is a response management system in place in the State of California that uses the principles of ICS and Unified Command. This system is the State Emergency Management System or SEMS. The basic problem is that federal, state and local environmental agencies have not conferred on how to implement the oil and hazardous material incident response plans developed under SEMS. There is not a clear and complete understanding of how all parties will work together in an efficient and effective manner during a response to a large scale oil or hazardous materials incident involving multiple agencies, multiple jurisdictions and authorities. Additionally, there is a lack of understanding and training in the principles and procedures of ICS/UC among many of the participating federal, state and local agencies.

The California Hazardous Materials Incident Contingency Plan (HMICP) describes in some detail the response management structure, the predesignated Incident Commanders and agency roles and responsibilities, capabilities and limitations. According to the HMICP, the predesignated IC for On-Highway spills (incorporated, excluding freeways) is the Law Enforcement Agency with primary traffic investigative authority. For On-Highway spills (Unincorporated roadways, including all freeways) it is the California Highway Patrol. For Off-Highway spills it is the Responsible Local Official in whose jurisdiction an incident requiring mutual aid has occurred.

However, the HMICP does not describe how the transition works from the initial "crises response" phase involving the preservation and protection of life and property to the "pollution response" phase involving the cleanup of the spill. In the first phase the responders typically include local fire, police and health officials. In the second phase the response group can get much larger as environmental agencies from Federal and State government arrive at the scene. In these situations, the command structure usually goes through a transition from an ICS that uses a direct incident command to an ICS that uses a unified command. Additionally, there usually is a complete transfer of command from law enforcement or fire agencies to the environmental agencies. It is at this point that the HMICP is not clear as to which State or local agency will be represented in the unified command and be empowered as the local or State Incident Commander. Most local police, fire and health officials are not qualified to direct and manage a large pollution response effort.

At the Westley Tire Fire, a true ICS response management structure was never established at the field level. Most of the State and local agencies were unfamiliar with ICS and, consequently did not play by the ICS rules. The State and local agencies had representation within the Unified Command. However, these individuals were not empowered to make decisions on behalf of the State and local agencies they represented and were unfamiliar with their roles as IC's within the Unified Command. The State and local IC's were not on-scene and worked from their offices. As a result, the EPA OSC made most field decisions without consultation with the other unified commanders.

In accordance with the rules of Unified Command, no actions that might affect the response should be taken without approval of the Unified Command. Several State agencies operated independently of the Unified Command in variance of the principles of ICS. The RWQCB issued Clean-Up and Abatement Orders to the responsible parties without prior notice to the UC. This caused problems because the responsible parties were ordered to perform work which could interfere with ongoing emergency response actions. The DTSC initiated enforcement action against the oil recycler used by EPA, Evergreen Oil, for accepting the pyrolytic oil. This again was conducted without prior consultation with the UC. This action resulted in the return of 4500 gallons of oil and discontinued use of Evergreen services. The enforcement action was later rescinded by the State. The following sections were taken from SEMS:

"Any process used by the unified command must permit the command team to develop a consolidated action plan that adequately reflects the jurisdictional needs of the agencies with responsibility for the incident. **Unified command is based on the presumption that all responsible agencies will cooperate in a collective effort to mitigate an incident."**

"It is impossible to implement unified command unless the responsible agencies have agreed to participate in the process. Once this has been achieved, incident management goals, objectives and strategies are established through a consensus process" (SEMS).

The California State Emergency Management System (SEMS) and Hazardous Materials Incident Contingency Plan (HMICP) specifically state that State agencies will use the ICS/UC response management structure. All local government must use SEMS to be eligible for state reimbursement for their response-related costs in multi-agency or multi-jurisdictional emergencies. These plans provide some information on agency responsibilities in support of a spill response, but these plans and procedures are not either read, understood or followed. Few State agencies appear to be trained in ICS. Additionally, EPA is unaware which State agencies have jurisdiction and responsibilities at a hazardous material incident and whether they conduct exercises or drills to practice the use of ICS as required by SEMS and HMICP plans. Two State agencies, DFG/OSPR and CDF, are trained in the use of ICS. Both CDF and OSPR have implemented ICS numerous times at wild land fires and oil spills, respectively. DFG/OSPR and USCG provided on-scene assistance at the Westley Tire Fire but most agencies were just too unfamiliar with the principles of ICS to make it work.

The State does not have predesignated individuals that are qualified, trained and empowered to act as the State Incident Commander during **hazardous material incidents**. DFG and CDF have qualified individuals for response to marine/inland oil spills and fires on State lands, respectively. The California Vehicle Code states that the CHP is the IC for hazardous material incidents on State highways and County roads. The State IC for off-highway incidents is still unclear. The California Fish and Game Code designates DFG as the trustee of fish, wildlife, and natural resources, but does not explicitly designate DFG as the IC at off-highway incidents, as is often assumed. The California Government Code does, however, designate the Administer of OSPR as the IC at oil spill incidents in marine waters of the state. Other agencies that will participate or support the response effort, but not actually take the role of an IC, must also be trained in the use of the ICS and evaluate how their organization will fit into the ICS. The following section is taken from SEMS:

"Agencies that will be partners in a unified command situation should, whenever possible, **establish agreements in advance of emergency incidents that identify jurisdictional and functional responsibilities and delineate the elements of the unified command structure**. In addition, agencies should take every opportunity to exercise the provisions of these agreements through periodic training and simulation drills."

The State has very limited resources to abate, mitigate and manage a major spill event. Currently, the State depends on EPA OSCs and federal resources to conduct emergency response and removal actions (especially if there are no viable responsible parties to conduct the response) under their CERCLA and OPA authorities. Because EPA has such a major role in oil and hazardous material response actions in California, it is imperative that preparedness and planning efforts are a joint effort by state and federal responders. Currently, State emergency response plans are developed without input from EPA OSCs. Unlike the USCG for marine response, the EPA for inland response has not developed broad area contingency plans (ACPs) or area committees consisting of stakeholders to develop these plans. EPA has several ACPs for specific environmentally sensitive geographic areas (Tahoe Basin, Feather River Area, Colorado River, Upper Sacramento Area, and Border Area). However, these do not fully address the statewide problems of coordination between Federal, State and local agencies during a major hazardous material incident. The following sections were taken from SEMS:

"A basic precept of unified command is that jurisdictional authorities responsible for the incident are never excluded from the command structure. The legal requirements for federal, state, and local agencies must be taken into account when developing a consolidated action plan. **Exactly how those jurisdictional authorities function in the unified command is a matter to be determined according to the details of the incident and the parties involved."**

"It is essential to the success of efficient emergency management that jurisdictions and functional agencies <u>**preestablish the unified command structure and conduct frequent drills to exercise the system."**</u>

Recommendations:

1. **Establish a readiness work group involving key responders from federal and state agencies to work on making changes to improve response and coordination in the State of California.**

2. **Provide a forum that will create an opportunity to improve the working relationships among responders from federal, state and local agencies who will likely participate in the ICS during a major oil or hazardous materials incident.**

3. **Develop a conceptual ICS/UC organizational chart that can be used for large scale oil and hazardous material responses. However, responders should have flexibility to use the concepts of ICS/UC without the resource requirements of a full-blown ICS organization. The size, complexity and duration of an incident should dictate whether the ICS/UC be applied in a formal or informal manner. Informal response systems can be effectively implemented and successfully executed without the formality of standard forms, charts and multiple ICS positions.**

4. **Establish generic response functions that are common to most oil and hazardous material response operations.**

5. **Identify each agency or group that may participate in a response and their functional role in the ICS command and general staffing positions.**

6. **Establish operational guidelines for all agencies that will likely participate on the response or be called upon for assistance (e.g., commitment to work in the field, share resources, chain-of command, responsiveness, etc.). Regulatory programs need to be more responsive when assistance is requested by the Unified Command (e.g., requests for emergency variances or permits).**

7. **Prescript or preplan initial actions to some degree by developing a short-list of generalized objectives that will guide a large response organization and drive the response in the right direction during the early stages of the response. Consider preassigned responsibilities and other ways to speed up the response and ensure the response organization will be cohesive, effective and sustained.**

8. **Develop boilerplate plans that consolidate various agencies' requirements for health & safety, air monitoring, communications, public relations, waste disposal, sampling and cleanup, etc. Existing plans may be used or refined.**

9. **Establish a procedure for making the transition from the crisis response (panic) phase to the pollution response (project) phase. It must ensure that environmental agencies are**

smoothly integrated into the existing ICS structure.

10. **Use existing training programs (e.g., EPA ERT, U.S. Coast Guard, CAOES CSTI) to develop and deliver specialized training in the use of ICS/UC during a major oil spill or hazardous material incident. The training should take into account the uniqueness and complexity of inland area response.**

11. **Develop fact sheets or newsletters that would update federal, state and local agencies and industry on new developments in multi-agency, multi-jurisdictional response and coordination and continue an open dialogue on the subject. Develop methods for making the lessons learned system work better (i.e., facilitating a positive learning experience without placing blame, neutralizing liability concerns, building trust, etc.).**

12. **Obtain buy-in and commitment from management.**

IV. Information on Emergency Permits

For Emergency Permit requests that don't involve open burning or open detonation (OB/OD), the requestor should follow the regulatory requirements provided below and depending on the regional location of the subject site, contact the following Branch Chiefs directly:

Sacramento:	Jim Pappas	(916) 255-3553
Berkeley:	Mohinder Sandhu	(510) 540-3974
Glendale:	Jose Kou	(818) 551-2920
Cypress:	Karen Baker	(714) 484-5423

For Emergency Permit requests that involve OB/OD, DTSC is developing a guidance that describes specific steps DTSC personnel should follow to process such requests in a timely and appropriate manner. Jan Smith at DTSC (916-324-0705) is facilitating this effort, which still needs additional changes before becoming final. One unique procedural step proposed in this guidance is to have OB/OD emergency permit requestors contact one particular Point-of-Contact at DTSC. This centralized coordination should help ensure consistency and standardization in how such OB/OD requests are processed. This guidance was developed with the input and coordination of DTSC's Permitting, Site Mitigation, and Office of Military Facilities Offices, and with assistance from EPA Region 9's RCRA Permits Office.

In the meantime California's hazardous waste regulations address Emergency Permits as follows:

California Code of Regulations
Title 22, Division 4.5
§66270.61. Emergency Permits.

(a) Notwithstanding any other provision of this chapter or chapter 21 of this division, in the event the Department finds an imminent and substantial endangerment to human health or the environment the Department may issue a temporary emergency permit:

(1) to an otherwise non-permitted facility, including but not limited to, a facility operating pursuant to interim status or a

variance, etc., to allow transfer, treatment, storage, or disposal of hazardous waste; or

(2) to a permitted facility to allow transfer, treatment, storage, or disposal of a hazardous waste not covered by an effective permit.

(b) This emergency permit:

(1) may be oral or written. If oral, it shall be followed in five days by a written emergency permit;

(2) shall not exceed 90 days in duration;

(3) shall clearly specify the hazardous wastes to be received, and the manner and location of their transfer, treatment, storage, or disposal;

(4) may be terminated by the Department at any time without process if it is determined that termination is appropriate to protect human health or the environment;

(5) shall be accompanied by a public notice published under section 66271.9 including:

(A) name and address of the office granting the emergency authorization;
(B) name and location of the permitted HWM facility;
(C) a brief description of the wastes involved;
(D) a brief description of the action authorized and reasons for authorizing it; and
(E) duration of the emergency permit; and

(6) shall incorporate, to the extent possible and not inconsistent with the emergency situation, all applicable requirements of this chapter and chapters 14 and 16 of this division.

Authority cited: Sections 208, 25150 and 25159, Health and Safety Code
Reference: Sections 25159 and 25159.5, Health and Safety Code; 40 CFR Section 270.61.

V. Reference List for Tire Fires

1. Adolfson Associates, Inc. in Association with Coble, Kim; "Tire Fire Contingency Plan-Toxicology Aspects," Prepared for Tacoma-Pierce County Health Department, Tacoma, WA, September 1994.

2. California Office of State Fire Marshal; "Rings of Fire - Fire Prevention and Fire Suppression of Scrap Tire Piles", California State Fire Marshal, Sacramento, CA, ($18 plus S&H, can be ordered from the California Dept. of Forestry, Sacramento, CA, phone # 916-445-8158).

3. California Office of State Fire Marshal; "Rings of Fire"(video), California State Fire Marshal, Sacramento, CA, ($25 plus S&H, can be ordered from the California Dept. of Forestry, Sacramento, CA, phone # 916-445-8158).

4. Ecology & Environment, Inc.; "Conceptual Air Surveillance Program for Tire and Landfill Fires", Report for U.S. EPA Region 9 On-Scene Coordinator, Dan Shane, San Francisco, CA..

5. Environmental Sciences International, Inc.; "Technical Bulletin Number Two: Tire Fire Management.", ESE, Inc. Office of Technical Services Fire Protection Engineering, Glouchester, MA.

Environmental Sciences International, Inc.; "Technical Bulletin Number Seven: The Science of Tire

Fires Prevention and Recovery Measures.", ESE, Inc. Office of Technical Services Fire Protection Engineering, Glouchester, MA.

Horrigan, Liz; "Tire Fires: Toxic Exposure (Big Wheels keep on burning)", U.S. Dept. of Health and Human Services, Center for Disease Control, Agency for Toxic Substances and Disease Registry (ATSDR), Washington, DC, April 1999.

McPhee, John; "Duty of Care", The New Yorker Magazine, June 28, 1993, pp.72-80.

Office of the Fire Marshal; "One Bite at a Time: A Summary of the Report on the February 12, 1990 Tire Fire" (a.k.a. Hagersville Tire Fire), City of Nanticoke, Ontario, 1990.

Scrap Tire Management Council; "Scrap Tire Characteristics", Washington, DC, 1999 (available free via internet at http://www.rma.org).

Scrap Tire Management Council; "Scrap Tire Facts and Figures", Washington, DC, 1999 (available free via internet at http://www.rma.org).

Scrap Tire Management Council; "Guidelines for the Prevention and Management of Scrap Tire Fires.", Scrap Tire Management Council, Washington, DC ($15 plus S&H, order form available via internet at http://www.rma.org).

U.S. EPA; "About Portable Document Format Files", U.S. EPA, Washington, DC (available free via internet at http://www.epa.gov/epahome/pdf.html).

U.S. EPA; "Air Emissions From Scrap Tire Combustion", EPA/600/R-97/115, U.S. EPA Office of Research and Development, Washington, DC, October 1997, (available free via internet at http://www.epa.gov/ttn/catc/cica/cicaeng.html, 655kb, pdf format).

U.S. EPA; "Grawn, MI Tire Fire" (video), U.S. EPA ERT, Edison, NJ, (can be ordered, no charge, via internet at http://204.46.140.12/media_resrcs/media_resrcs.asp).

U.S. EPA; "OSC Report: Panoche Tire Dump Fire, Fresno County, CA", U.S. EPA Region 9, San Francisco, CA, March 1997, (103kb, bac, word processor, format).

U. S. EPA; "Project Summary: Air Emissions from Scrap Tire Combustion", EPA/600/SR-97/115, U.S. EPA Office of Research and Development, National Risk Management Research Laboratory, Cincinnati, OH, November, 1997 (available free via internet at http://www.epa.gov/ordntrnt/ORD/WebPubs/projsum/600sr97115.pdf, 18kb, pdf format).

U.S. EPA; "Tire Fires, A Burning Issue" (video), U.S. EPA ERT, Edison, NJ, (can be ordered, no charge, via internet at http://204.46.140.12/media_resrcs/media_resrcs.asp).

U. S. Fire Administration; Report to Congress, Federal Emergency Management Agency, US Fire Administration, Washington, DC, August 1998 (available free via internet at http://www.usfa.fema.gov/usfapubs/tirefirerep.htm, 93kb, pdf format).

U. S. Fire Administration; "Scrap and Shredded Tire Fires, Special Report 93", Federal Emergency Management Agency, U.S. Fire Administration, Washington, DC, December 1998, (available free via internet at http://www.usfa.fema.gov/techreps/tr093.htm, 1.08Mb, pdf format).

California Integrated Waste Management Board; "Construction Completion Report at Panoche Burn Site Remediation, Fresno County, California," Todd Thalhamer, CIWMB, December 1997. (available free via the internet at http://www.ciwmb.ca.gov/TireDisposal/Fires/Panoche)

California Integrated Waste Management Board's Tire Fire web page can be accessed at http://www.ciwmb.ca.gov/TireDisposal/Fires/

U.S. EPA; "OSC Report: Westley Tire Fire, Stanislaus County, CA", U.S. EPA Region 9, San Francisco, CA, Draft August 2000

U.S. EPA ERT, Weston Consultants' Report on Tire Fire Air Data Collected from Eight Tire Fires, WA#1286, August 21, 1989.

Bibliographies From The NFPA Web Site
http://www.nfpa.org/Research/Library/Bibliographies/Tire_Fires/tire_fires.html

Tire Fires Bibliography--May 1996

1. Baumgart, Don. Tire Energy. Comstock's [California Capitol Region]. 1993 Oct; Vol. 5(no. 10): pp. 41-45.

2. Bierwiler, Dave and Lea Ekman. Fire at Tire Mountain. Fire Command. 1987 Oct; Vol. 54(no. 10): pp. 18-19, 48-49.

3. Bullis, Tim. Tire Fire is Under Control: Units From Four States Remain at W. Virginia Site. Gaurd [Inwood, W. Virginia]. 1993 Sep 15.

4. Bullis, Tim and Nelson, Jeff. Tires Ablaze at Inwood: Arson Suspected. Gaurd [Inwood, W. Virginia]. 1993 Sep 15.

5. Calvan, Bobby. Mountain of Tires Still Not Moved. Record Searchlight [Redding, California]. ; 1993 Jun 29; Vol. 142, no. 109: pp. A1 & A8.

6. Came, Barry. The Fire Mountain: Battling the Blaze at Quebec Tire Dump. Maclean's. 1990 Jun 29; Vol.

103(no. 22): p. 50.

7. Coles, Clayton. Shasta College Tire Fire: Analyses. : Lawrence & Associates, Engineering Geologist; 1993 Jan 25.

8. Cowan, Richard. Rubber Tire Fire Gives Fireman a Workout. Pacific Coast Fire Journal. 1961 Dec: pp. 8-9.

9. Culkowski, W. M. , C. Nappo, B. Templeman, J. Wynn. A Photographic Study of a Massive Tire Fire. Atmospheric Enviromnent. 1984; Vol. 18(no. 4): p. 893.

10. D'Arcy, Jennings. A Balancing Act: Fighting the Tire Fire is Trial and Error: Hagersville, Ontario, Fourteen Million Tires on Fire, Arson Suspected. Maclean's. 1990 Mar 5; Vol. 103(no. 10): pp. 50(2).

11. Dilwali, Kumkum M. Environmental Contamination from Fires and Firefighting Activities. Cambridge, MA: Arthur D. Little; 1994.
36p.

12. Emergency Response Remedial Program Lessens Impact of Canadian Tire Blaze. Emergency Preparedness News. 1990 Mar 14: pp.77-78.

13. Experts Learning on the Job Fighting Fire in Pile of Tires. New York Times. ; 1983 Dec 4: p. 91 (L).

14. Firefighters Battle Tire Blaze. Associated Press. 1995 Apr 23.

15. Fischer, Jim. Air Quality Impacts of Burning Tires in Cement Kilns. : California Environmental Protection Agency, Air Resources Board; 1993 Jul.

16. Fumes from Dump Fire Worry Wisconsin Town. New York Times. ; 1986 Oct 22; N: p. 11.

17. Grady, Julie C. Tire Disposal Problem May Be Short-lived. Waste Age. 1987 Jan; Vol. 18(no. 1): pp. 34-44.

18. Green, Jay. The Science of Tire Fires. :

Environmental Sciences International Inc. (Technical Bulletin #7).

19. Guidlines for the Prevention & Management of Scrap Tire Fires. : Cooperative Publication between The Scrap Tire Management Council and The International Association of Fire Chiefs; 1993 Oct.

20. Harris, Hugh. Fire Companies from Four States Fight Tire Fire in West Virginia. Central Maryland News.

21. Hasegawa, H. K. and Staggs, K. L. Large Scale Test to Evaluate the Effectiveness of Various Fire Suppression Agents on Burning Stacked Tires. : Lawrence Livermore National Laboratory; 1991 Oct 5.

22. Hill, Waddell F. Demonstration Tire Burn - Pierce County, State of Washington [unpublished]. . 1989 May.
Note: Paper presented at Speaker Session #3, NFPA Annual Meeting, 1989.

23. Hill, Waddell F. Tire Fire Management Workbook/Guide. : Pierce County Fire Protection District.

24. Hodgkins, Joe E. Holding Pond Water & Site Sludge Analysis Re: Round-To-It Tire Recycle Fire. ; 1992 Sep 29.

25. Hodgkins, Joe E. Holding Pond Water EPA 624 Analysis Re: Round-To-It Tire Recycle Fire. ; 1992 Oct 26.

26. Hodgkins, Joe E. Metals in Holding Pond Re: Round-To-It Tire Recycle Fire. : Alpha Chemical & Biomedical Laboratories Inc.; 1992 Sep 30.

27. Howard, Hank A. National Tire Fire Disposal Problems Affecting the Fire Service. ; 1987.
Note: draft - 1987.

28. Howard, Hank A. Tires Burning by the Acre. Fire Engineering. 1988 Jun; Vol. 141(no. 6): pp. 22-26, 30, 33.

29. Huber, Marian. Evaluating the Risk to Human Health, Environment, and the Economy from Tire Fires [Draft]. : U.S. Army Corps of Engineers, Norfolk District.

30. A Huge Supply of Tires Burns for 5th Day in a Row. New York Times. ; 1981 Apr 27: p. 15.

31. Legzdins, Arnold. Analytical Chemistry in Hell: The 1990 Hagersville Tire Fire. Canadian Chemical News. 1991 Sep: pp. 33-34.

32. Loeb, Donald L. (Chief). Don't Pan the Plan. Fire Chief. 1996 Mar; Vol. 40(no. 3): pp. 60-63.

33. Loeb, Donald L. (Chief). Tires and Fires. Fire Chief. 1996 Mar; Vol. 40(no. 3): pp. 51-52, 54-56.

34. MacLeod, Robert. Gravel, Cement Dust Used to Douse U.S. Tire Blazes. The Globe and Mail. ; 1990.

35. Mawhinney, H. R. Different Strategies Used to Combat Canadian Tyre Fires. Fire International. 1990 Aug(no. 124): p. 11.

36. Mawhinney, H. R. The Hagersville Tire Fire [draft]. : Ottawa: National Research Council of Canada; 1990.

37. Mawhinney, H. R. The Tire Fire at Saint Amable, Quebec, May 16 to 19, 1990. : Ottawa: National Research Council of Canada; 1990. (Internal Report no. 595).

38. Mawhinney, H. R. Tire Fire Pollutes Environment. NFPA Journal. 1991 Jan; Vol. 55(no. 1): pp. 50-56 .

39. McInnes, Craig. Top Forest Fire Fighters Take Over From Volunteers Battling Tire Blaze. The Globe and Mail. ; 1990.

40. McKeon, Michael. Catskill Tire Conflagration Requires Implementation Of State Mutual-Aid Plan. Firehouse. 1989 Jun; Vol. 14(no. 6): pp. 88-93.

41. McTear, Ian. Tyre Dumps 'A Real Disaster Just Waiting to Happen'. Brigham Post [England]. ; 1990

Oct 25.

42. Millions of Tires Burn South of Dallas. The United Press International. 1995 Dec 1.

43. Month-old Fire in a Pile of Tires Has Experts Learning on the Job. New York Times. ; 1983 Dec 4; N,L: pp. 40, 91.

44. A Mound of Burning Tires Scars an Ontario Town. New York Times. ; 1990 Feb 26; N, A: p. 9.

45. Nappo, C. J. et al. Photo and Video Analyses of the Winchester, Virginia, Tire-Fire Smoke Plume. Fourth Joint Conference on Applications of Air Pollution Meteorology, Portland, OR, October 16-19,1984. Boston: American Meteorological Society; 1984. pp. 30-32.
pp. 30-32.

46. Neill, Mike. Catskill Tire Fire: Sampling Results. ; 1993 Nov 17. (; v. TAT-02-F-05605).

47. Nelson, Jeff. Local Fire Fighters Aid in West Virginia Tire Fire. Gaurd [Inwood, W. Virginia]. ; 1993 Sep 15.

48. Nuital, Nick. Tyre Piles Become a Burning Political Issue. The Time Home News [England]. ; 1990 Oct 23: p. 5.

49. Oil From Burning Tires Perils Aquatic Life at a Park in Ohio. New York Times. ; 1981 Aug 11; N, LC: p. 8, A10 respectively.

50. Papp, Leslie. Flames Out But Crews Still Fight Tire Fire Damage. Toronto Star. ; 1990.

51. Papp, Leslie. Huge Tire Fire Blaze Doused -- At Last. Toronto Star. ; 1990.

52. Peterson, J. C. et al. "Tire Fire Oil - Monitoring a New Environmental Pollutant". Analytical Chemistry. 1986 Jan; Vol. 58(no. 1): pp. 70A-72A, 74A.

53. Planck, Georgeanne. Westley Tire Pile Fire Could

Spark "Doomsday" Scenario. The Signal, 77th year. 1987 Nov 11(no. 18).

54. Pollution Alert Follows Canadian Tyre Fire. Fire [Overseas Supplement]. 1990 Jun; Vol. 83(no. 1020): pp. 1-2, 8.

55. Powis, Tim. Toxic Flames (Tyre King Recycling Ltd. Fire Near Hagersville, Ontario). Macleans. 1990 Feb 26; Vol. 103(no. 9): p. 47(1).

56. Rule, Charles. Declaration Regarding Tire Pile Fires. : Superior Court of California, for the County of Stanislaus; 1983 Jan 8.

57. Ryan, Jeffery V. Characterization of Emissions from the Simulated Burning of Scrap Tires. Research Triangle Park, NC: U.S. Environmental Protection Agency; 1989. (EPA-600/2-89-054).

58. Saint Amable, Quebec, Canada. Fire Prevention. 1991 Jul(no. 241): pp. 24-26.

59. Schmitt, Eric. Town's Rights, Others' Fears Vie Over Tire-burning Plant (Sterling, Connecticut; Struggle to assert local control over development that has regional impact). New York Times. ; 1989 Oct 15; N: p. 1.

60. Schneider, Keith. Fire Illuminates Massive Waste Disposal Problem: Buring Tires Spew Poisons Into Air, Water. Phoenix Gazette, Final. ; 1990 Mar 2; Front: p. A6.

61. Schneider, Keith. Worst Fire Inferno Has Put Focus on Disposal Probelm. (Tire Fire at Dump in Hagersville, Ontario.)
The New York Times. ; 1990 Mar 2; N, L, A: pp. 8, 10 respectively.

62. Scrap Tire Fires Are Costly [from Nation's Cities Weekly]. Minnesota Fire Chief. 1992 Nov; Vol. 29(no. 2): p. 21.

63. Sherman, David W. Buffalo Firefighters Battle Inferno; Third to Strike Nursery Company in Eight Years. Firehouse. 1989 Jun; Vol. 14(no. 6): pp. 88-91.

64. Slaughter, Rodney. Pointers for a Tire-Some Problem. Fire Chief. 1996 Mar; Vol. 40(no. 3): pp. 57-59.

65. Slaughter, Rodney A. Rings of Fire; Fire prevention & fire suppression of scrap tire piles. Sacramento, CA: California Office of the State Fire Marshal; 1993.

66. Slaughter, Rodney. Rings of Fire: What You Should Know About Tire Pile Hazards. American Fire Journal. 1994 Aug; Vol. 46(no. 8): pp. 20-22, 24, 26, 28-30.

67. Smith, E. D. Inwood Tire Fire Task Force Report. The Maryland Fire Dispatch. 1994 Feb 15; Vol. 10(no. 3): pp. 51-52.

68. Socha, Adam C. Report Background Information and Review of Health Risks, Tyre King Fire. Memorandum. : Ontario Ministry of the Environment; 1989 Oct 22.

69. Stanley, Pat. Tire Fire Extinguished in AmCan: Health Officials Investigating Potential Hazards. Register [Napa]. 1993 Sep 29: p.1A.

70. Stofferahn, Jeffey A. and Verneta Simon. Emergency Response to a Large Tire Fire: Reducing impacts to public health and the environment. Haztech International (Pudvan) Conference, St. Louis, August 26-28, 1987. Illinois: Dames & Moore; EPA; 1987: pp. 483-496.

71. Sweeny, James. Dumped Tires Growing Into a Mountain of Woe. The Press Democrat, [Santa Rosa]. ; 1993 Mar 7; no. 135.

72. Thomson, Dave. Hagersville, Ontario, Tire Fire Burns for 17 Days. Firehouse. 1990 Jun; Vol. 15(6): pp. 86-87.

73. Tire Fire: Hagersville Nightmare. Fire Fighting in Canada. 1990 Mar; Vol. 34(no. 2): pp. 6-7.

74. Tire Fire: Hagersville Wrap Up. Fire Fighting in Canada. 1990 Jun; Vol. 34(no. 4): pp. 6-7.

75. Tire Fire Foam on Sale. Toronto Sun. ; 1990 Mar
76. Tire Fire to Burn Itself Out. Fire Control Digest. 1990 Nov; Vol. 16(no. 11): pp. 5-6.

77. Tire Fire Will Be Allowed To Burn Out. St. Paul Pioneer Press Dispatch, AM Metro Final. ; 1990 Apr 21; Metro: 10A.

78. Tire Fires Can Be Prevented Through Recycling Waste-to-Energy Use. PR Newswire. 1990 Mar 13(0313NYFNS1).

79. Tyre Fires - a Pile of Pollution. Fire Prevention. 1991 Jul(no. 241): pp. 22-23.

80. U.S. Environmental Protection Agency, Emergency and Remedial Response. Superfund Record of Decision: Rhinehart Tire Fire Dump, VA. Washington, D.C.: U.S. Environmental Protection Agency; 1988. (EPA/ROD/F03-88-050).

81. U.S. Environmental Protection Agency, Technical Assistance Team for Region X. Tire Fire Investigation, Everett, Washington, 25 September to October 1984. Seattle: Environmental Protection Agency; 1984.

82. U.S. National Institute for Occupational Safety and Health, Centers for Disease Control. Health Hazard Evaluation Report: Rhinehart Tire Fire, Winchester, Virginia. Cincinnati, Ohio: U.S. NIOSH; 1984. (HETA 84-044-1441).

83. Verhovek, Sam Howe. Fiery "Mountains of Tires" Defy Firefighters at New York Dump. New York Times. ; 1989 Mar 1; N, L, A, B: pp. 17, 1 respectively.

84. Walsh, Mary Williams. Fire Threatens Disaster in Canada...(Burning Tires Near Hagerville). Los Angeles Times. ; 1990 Feb 21; A: p. 5.

85. Webber, Maura. Struggling to Apply Brakes to a Mounting Tire Problem: The Mounds Are an Eyesore. When They Catch Fire, They Become Real Environmental Hazard. Philadelphia Inquirer. ; 1992 Aug 6.

86. Wong, Tony and Bill Taylor. Dikes Hold Back Oil Flowing From Blazing Tires. Toronto Star. ; 1990 Feb 15; A: p. 12.

87. Wong, Tony. Tire Blaze Not A Disaster, Scientists Say. Toronto Star. ; 1990 Apr 12.

88. Youth Admits Tossing Gas on Hagersville Tires. Fire Fighting in Canada. 1991 Jun; Vol. 35(no. 4): p.

89. Zarpas, Stephanie. Tires on Fire. The Conservationist. 1990 Feb; Vol. 44(no. 5): pp. 14-17.